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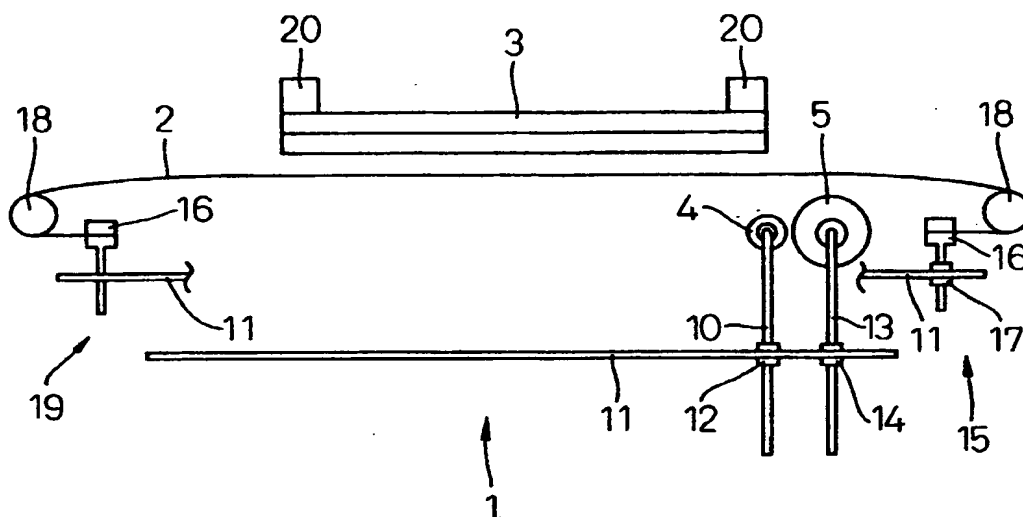
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(54) Title: SHEET-ADHESION DEVICE



(57) Abstract: A device to adhere an adhesive sheet on an object in a predetermined position in a uniform and desired manner without the puckering of the sheet and the entrapment of the air. The device includes a sheet-adhesion device for holding an adhesive sheet near an object. The tensioned sheet is positively pressed against the object using one or more applicators.

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SHEET-ADHESION DEVICE

Description of the Invention

The present invention relates to a sheet-adhesion device.

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Description of the Related Art

Nowadays, a coloring of a car body has mostly been carried out by a painting technology. The coloring according to the painting technology, however, has an inconvenience in that the painting operation must be carried out while preventing the sags and runs of a paint from occurring. Also, the painting operation is liable to cause the unevenness in color.

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To solve the above-mentioned drawbacks, there has recently been a trial in that sheets, each having a desired color, are adhered to a car body to color the same. According to such an adhesion technology, it is possible to overcome the above-mentioned problems in the painting technology; i.e., the inconvenience due to the sags and runs as well as the difficulty accompanied with the liability of color unevenness.

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Problems to be Solved by the Invention

Conventionally, an adhesive sheet or film is manually adhered to an object, using a squeegee. In this manner, an adhesive sheet is positioned on the object in position and adhere to the object in such a manner that the puckering of the adhesive sheet and the involvement of the air between the adhesive sheet and the object are avoided. When the puckering of the adhesive sheet or the involvement of the air occurs, the puckering portion or the air involved portion is moved and eliminated by pressing and moving the squeegee, and thereby the adhesive sheet is completely adhere to the object. The removal of air from beneath the adhesive sheet is difficult to accomplish. Further, when a large adhesive sheet is adhered to the object, it is difficult for one person to position the adhesive sheet on the object in a predetermined position, and adhere the sheet to the object. Even if a plurality of persons adhere the adhesive sheet to object, there is a possibility that the portion

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of the sheet other than that to be adhered, is adhered to a portion of the object other than the desirable portion to be adhered. Therefore, it becomes difficult to adhere the adhesive sheet to the object, and the puckering of the adhesive sheet and the formation of pockets easily occurs. In particular, this is true in the case that the object has a curved profile, or flat and curved profiles. In this case, the positioning and adhesion processes over the curved profiles cause the puckering of the adhesive sheet and the formation of air pockets.

It would be an advantage to provide a sheet-adhesion device which can overcome the above-mentioned problems, and which can adhere precisely an adhesive sheet on an object in a predetermined position in a uniform and desired manner without the puckering of the sheet and the formation of air pockets.

Summary of the Invention

To solve the above-mentioned problems, according to a first aspect of the present invention, a sheet-adhesion device for adhering an adhesive sheet to an object is provided, comprising a tensioning device for holding an adhesive sheet under tension adjacent to an object, and an applicator for pressing the tensioned adhesive sheet against the object, whereby the tensioned adhesive sheet is adhered to the object. According to this aspect, the adhesive sheet is pressed onto the object while being maintained under tension.

According to a second aspect, the tensioning device is able to adjust the tension.

According to a third aspect, the applicator is moved at a direction along the longitudinal direction of the adhesive sheet.

According to a fourth aspect, the applicator is reciprocated along the longitudinal direction of the adhesive sheet.

According to a fifth aspect, the applicator comprises at least one roller having a surface which is conformable with the profile of the object when the roller presses the adhesive sheet to the object.

According to a sixth aspect, the applicator comprises a plurality of rollers, each of rollers has a surface which is conformable with different profiles of the object when the roller presses the adhesive sheet to the object.

According to a seventh aspect, the applicator has a pressing surface made of an elastic material.

Brief Description of the Drawings

5 The invention will be more fully appreciated with reference to the following drawings in which similar reference numerals designate like or analogous components throughout and in which:

Figs. 1-6 are schematic views of a sheet-adhesion device according to the present invention;

10 Fig. 7 is a perspective view of a cylindrical roller suitable for use with the present invention;

Fig. 8 is a perspective view of a conical frustum roller suitable for use with the present invention;

Fig. 9 is a sectional view taken along a datum 9 in Fig. 3;

15 Fig. 10 is a sectional view taken along datum 10 in Fig. 6; and

Fig. 11 is a partial cross-sectional view of an adhesive sheet suitable for use with the present invention.

Detailed Description

20 A sheet-adhesion device according to the present invention will be described in more detail below with reference to the attached drawings. First, a structure of the sheet-adhesion device will be explained and then the operation thereof will be explained.

25 With reference to Fig. 1, reference numeral 1 generally denotes a sheet-adhesion device according to the present invention; 2 a sheet to be adhered (hereinafter referring to as an "adhesive sheet"); and 3 an object on which the adhesive sheet is adhered (hereinafter referred to as an "object"). In this embodiment, the object 3 is a car body and is hold by the holding means or device 20, and the adhesive sheet 2 is that for coloring the car body.

30 The sheet-adhesion device 1 comprises an applicator for adhering the adhesive sheet 2. The applicator of the invention can include conventional elements in various forms such as, for example, a roller or a squeegee. Preferably,

the sheet-adhesion device 1 is provided with two rollers 4 and 5. The one roller 4 in these rollers is a generally cylindrical roller as shown in Fig. 7 (hereinafter referred to as a "cylindrical roller"). The other roller 5 consists of a pair of generally conical frustum roller elements 5a and 5b arranged opposite to each other as shown in Fig. 8 (the roller being hereinafter referred to as a "conical frustum roller").

As indicated in Fig. 7, the cylindrical roller 4 is formed of a metallic core 6 covered with an elastically deformable layer 7 made of an elastic material such as polyurethane. Thereby, an elastically deformable pressing surface is provided to the cylindrical roller 4. As indicated in Fig. 8, each of the conical frustum roller elements 5a and 5b is formed of a metallic core 8 covered with an elastically deformable layer 9 made of an elastic material such as polyurethane. Thereby, an elastically deformable pressing surface is provided to the conical frustum roller 5.

The following description generally refers to Figs. 1-6, unless otherwise noted. The cylindrical roller 4 is coupled to a main frame 11 via a sub-frame 10. The sub-frame 10 is, in turn, coupled to the main frame 11 via an actuator 12. The actuator 12 causes the cylindrical roller 4 to be movable along the main frame 11 and also to be movable in the vertical direction relative to the main frame 11.

The conical frustum roller 5 is coupled to the main frame 11 via a sub-frame 13. The sub-frame 13 is, in turn, coupled to the main frame 11 via an actuator 14. The actuator 14 causes the conical frustum roller 5 to be movable along the main frame 11 and also to be movable in the vertical direction relative to the main frame 11.

On the other hand, the sheet-adhesion device 1 is also provided with sheet-holding/stretching devices 15, 19 for stretching the adhesive sheet 2 to be adhered while holding the latter under a predetermined tension. Each of the sheet-holding/stretching devices 15, 19 has a holder 16 as means for holding each of opposite ends 2a of the adhesive sheet 2. The holder 16 could include, for example, conventional mechanical clamping devices or adhesives for securing a portion of an application tape 2c as described below in more detail so as to allow the application tape 2c to be tensioned. The holder 16 of the device 15 is coupled to the main frame 11 via an actuator 17. The actuator 17 causes the holder 16 to be

movable along the main frame 11. In this regard, as shown in Fig. 11, the adhesive sheet 2 consists of an adhesive film 2b to be adhered to the object 3, and an application tape 2c for supporting the adhesive film 2b. The adhesive backed film 2b is an adhesive backed article with suitable adhesives and film backings. For example, a suitable adhesive backed film is PU-2957 which is available from Sumitomo 3M Company in Japan. Further, a suitable application tape is, for example, SCT2010J which is available from Sumitomo 3M Company in Japan. As shown in Fig. 11, an optional release liner 2d or paper can be releasably bonded to the adhesive of the adhesive backed film to protect the adhesive backed film. The release liner 2d is then removed prior to application of the adhesive sheet to the object. For example, a suitable release liner is JIMT106 which is available from Sumitomo 3M Company in Japan. A plurality of apertures 2e are provided in the respective end portion 2a of the application tape 2c. The holder 16 is capable of holding the application tape 2c of the adhesive sheet 2 by inserting pins (not shown) provided thereon into the apertures 2e. Further, the application tape 2c is a support for supporting the adhesive film 2b in order to adhere precisely the adhesive film 2b to the object 3 in a desired position while maintaining the relation between the adhesive film and the object. In addition, the substrate of the application tape 2c is made of a material which has much flexibility and elasticity than that of the adhesive backed film.

Further, each of the sheet-holding/stretching devices 15, 19 is provided with a holding roller 18 arranged adjacent to the respective holder 16. The holding roller 18 has a sufficient size for winding the adhesive sheet 2 around the same.

A basic principle of the present invention will be briefly explained prior to describing the operation of the sheet-adhesion device according to the present invention in detail.

As described above, the object of the present invention is to easily adhere the adhesive sheet at a desired position on the object in a uniform and desired manner while avoiding the air involvement between adhesive sheet and the object. To achieve this object, the present invention mainly has the following two characteristics:

First of the characteristics is to maintain the adhesive sheet under a predetermined tension during the adhesion of the adhesive sheet onto the object. This is achieved by the sheet-holding/stretching devices 15, 19. Since the air involvement between the adhesive sheet and the object is mainly originated from the slack of the adhesive sheet during the adhering operation, it is possible to prevent air from being involved between the adhesive sheet and the object, by adhering the adhesive sheet onto the object by means of the roller while maintaining the adhesive sheet under the tension.

Second of the characteristics is to adhere the adhesive sheet onto the object while using a plurality of rollers having different profiles. This is achieved by the cylindrical roller 4 and the conical frustum roller 5. Generally speaking, there is a rare case wherein an overall profile of the object is flat and plain, but in most cases, the profile is rather curved, or contoured. The air involvement between the adhesive sheet and the object is mainly caused by the difficulty of conforming the adhesive sheet with the curved profile of the object. According to the present invention, however, the profile of the object is divided into a plurality of surface sections, each being considered as generally flat and curved sections, and a plurality of rollers, each having a flat surface corresponding to the respective surface section, are used for the adhering operation. Thereby, it is possible to prevent air from being involved between the adhesive sheet and the object by the use of these rollers.

As described above, the positioned adhesive sheet is adhered to the object by first pressing the generally central region of the object by means of the cylindrical roller, while the air is moved from the central region to the longitudinal edges of the adhesive sheet. Next, the region of the both longitudinal edges of the object is pressed and adhered by the conical frustum roller to move the air out of the adhesive sheet.

Next, the operation of the sheet-adhesion device 1 will be described in more detail with reference to the attached drawings. First, as shown in Fig. 1, the adhesive sheet 2 is attached at its one end to the holder 16 of the device 19 while being partly wound around the holding rollers 18 of the device 19 and at its other end to the holder 16 of the device 15 while being partially wound around the

holding rollers 18 of the device 15. In this stage, the adhesive sheet 2 is not in a stretched state. Then, as shown in Fig. 2, the actuator 17 operates to move the right side holder 16 in a longitudinal direction of the adhesive sheet 2 along the main frame 11 to be closer to the left side holder 16. Thus, the adhesive sheet 2 is
5 opposed to the object 3 under the predetermined tension. In this regard, the release liner 2d has been released from the adhesive sheet 2 prior to this state.

Thereafter, as shown in Fig. 3, the actuator 12 operates to move the cylindrical roller 4 toward the object 3 in the vertical direction relative to the main frame 11 and force the cylindrical roller 4 against the object 3 while interposing
10 the adhesive sheet between the roller 4 and the object 3. In other words, the cylindrical roller 4 corresponds to an applicator for positively pressing the adhesive sheet 2 against the object 3. At that time, as shown in Fig. 9, the cylindrical roller 4 is pressed against generally a central area of the object 3. The surface of the cylindrical roller 4 is elastically deformed to conform with the profile of the object
15 3.

As shown in Fig. 4, the actuator 12 operates to move the cylindrical roller 4 in the longitudinal direction of the adhesive sheet 2 along the main frame 11 while pressing the cylindrical roller 4 against the object 3. Thus, the adhesive sheet 2 is adhered to the central area of the object 3.

20 Then, as shown in Fig. 5, the actuator 12 operates to move the cylindrical roller 4 away from the object 3 in the vertical direction relative to the main frame 11. Simultaneously therewith, the actuator 14 operates to move the conical frustum roller 5 toward the object 3 in the vertical direction relative to the main frame 11 so that the conical frustum roller 5 is pressed against the object 3 while
25 interposing the adhesive sheet 2 between the both. In other words, the conical frustum roller 5 corresponds to an applicator for positively pressing the adhesive sheet 2 against the object 3. At that time, the conical frustum roller 5 is being pressed against areas on the opposite sides of the central area of the object 3, as shown in Fig. 10. The surface of the conical frustum roller 5 is also elastically
30 deformed to conform with the profile of the object 3.

Thereafter, as shown in Fig. 6, the actuator 14 operates to move the conical frustum roller 5 in the longitudinal direction of the adhesive sheet 2 along the main

frame 11 while pressing the conical frustum roller 5 against the object 3. Thus, the adhesive sheet 2 is adhered to the areas on the opposite sides of the central area of the object 3.

5 Finally, although not illustrated, the actuator 14 operates to move the conical frustum roller 5 away from the object 3 in the vertical direction relative to the main frame 11. The application tape 2c of the adhesive sheet 2 is removed from the holders 16 and is peeled off from the adhesive film 2b. Thus, the sheet-adhering operation is completed and the device is ready for the next adhering operation.

10 Further, the cylindrical roller 4 and the conical frustum roller 5 which is located behind the roller 4 may be simultaneously moved and pressed to the object via the adhesive sheet in order to adhere the adhesive sheet to the object.

As described above, according to the present invention, it is possible to adhere the adhesive sheet through the above-mentioned processes without
15 involving, or entrapping, air between the adhesive sheet and the object.

Although a plurality of rollers are employed in the above embodiment, it does not limit the invention.

Thus, according to the present invention, the adhesive sheet is pressed against the object while maintaining a stretched state. That is, there is no slack in
20 the adhesive sheet during the adhering operation. Thereby, it is possible to adhere the adhesive sheet to the object without the air involvement between the adhesive sheet and the object.

What is claimed is:

1. A sheet-adhesion device for adhering an adhesive sheet to an object,
comprising a tensioning device for holding an adhesive sheet under tension
5 adjacent to an object, and an applicator for pressing the tensioned adhesive
sheet against the object, whereby the tensioned adhesive sheet is adhered to
the object.
2. A sheet-adhesion device as defined by claim 1, wherein the tensioning
10 device is able to adjust the tension.
3. A sheet-adhesion device as defined by claim 1, wherein the applicator is
moved at a direction along the longitudinal direction of the adhesive sheet.
- 15 4. A sheet-adhesion device as defined by claim 1, wherein the applicator is
reciprocated along the longitudinal direction of the adhesive sheet.
5. A sheet-adhesion device as defined by claim 1, wherein the applicator
comprises at least one roller having a surface which is conformable with
20 the profile of the object when the roller presses the adhesive sheet to the
object.
6. A sheet-adhesion device as defined by claim 1, wherein the applicator
comprises a plurality of rollers, each of rollers has a surface which is
25 conformable with different profiles of the object when the roller presses the
adhesive sheet to the object.
7. A sheet-adhesion device as defined by claim 1, wherein the applicator has a
pressing surface made of an elastic material.
- 30 8. A method for applying an adhesive strip onto an object, comprising
pressing an adhesive sheet against an object utilizing the device of claim 1.

9. A method for applying an adhesive strip onto an object, comprising
- (a) holding an adhesive sheet under tension near an object suitable for receiving said adhesive sheet; and
- 5 (b) pressing said adhesive sheet against the object with one or more applicators to bond said adhesive sheet to the object without the entrapment of air between said adhesive sheet and said object.
10. A method as recited in claim 9, wherein said one or more applicators is a
- 10 cylindrical roller or a conical frustrum roller.

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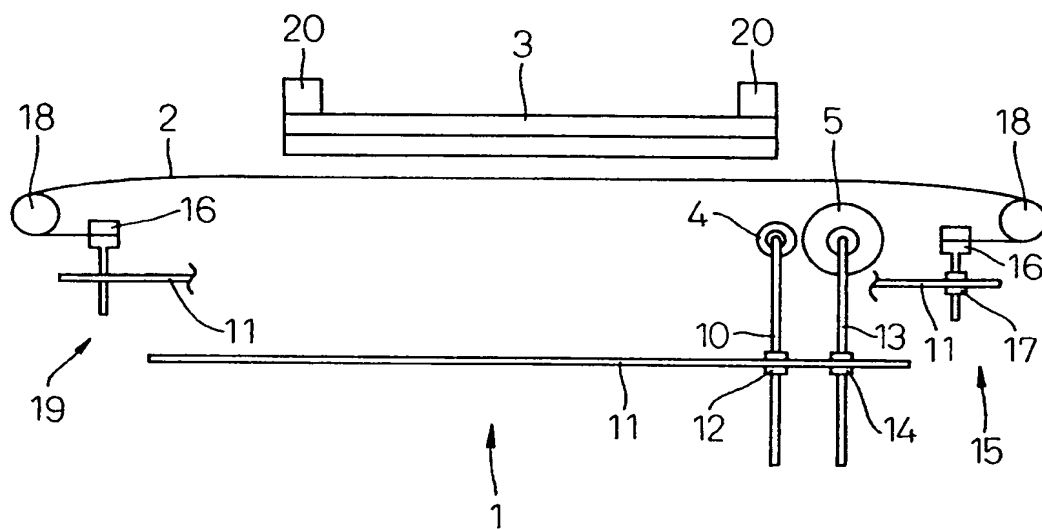


Fig. 1

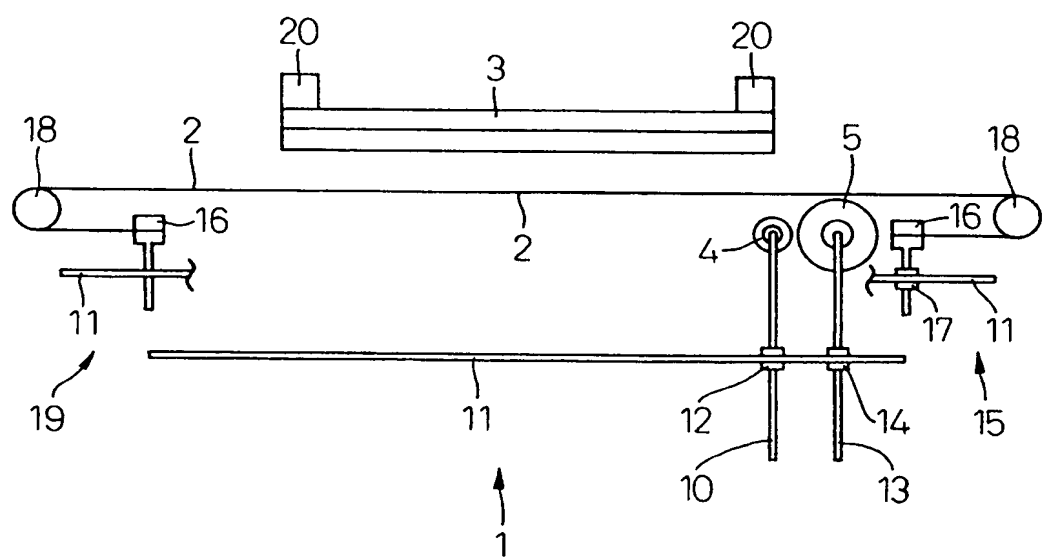
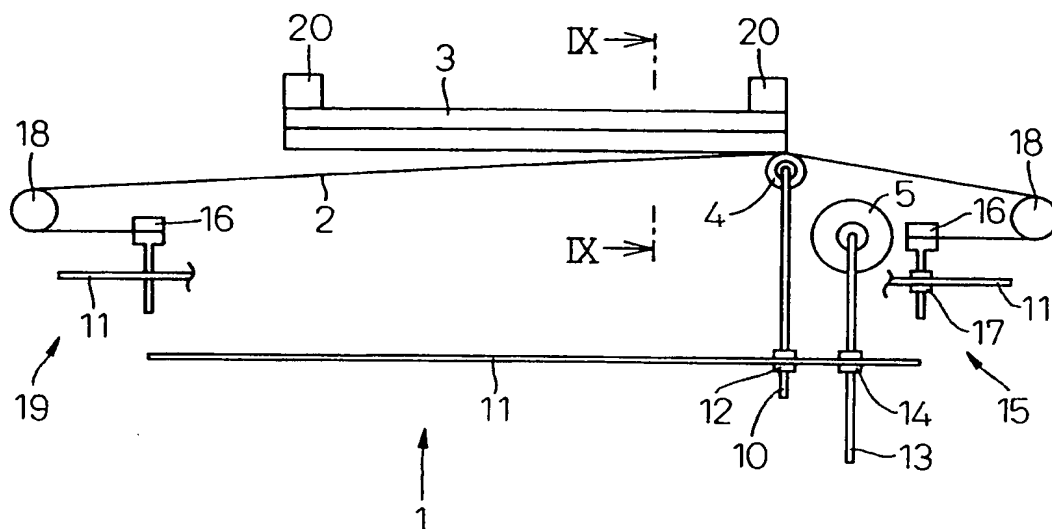
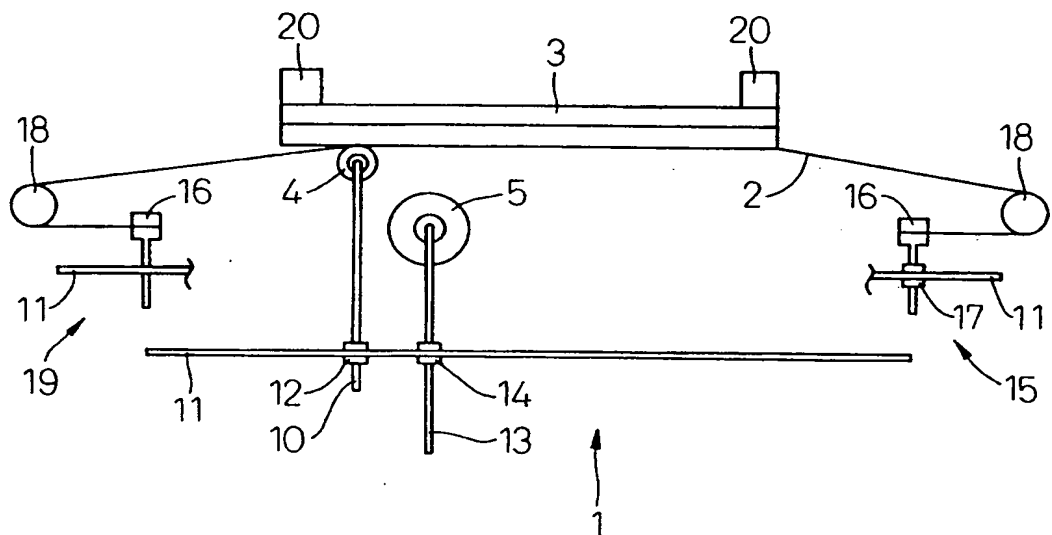


Fig. 2

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**Fig. 3****Fig. 4**

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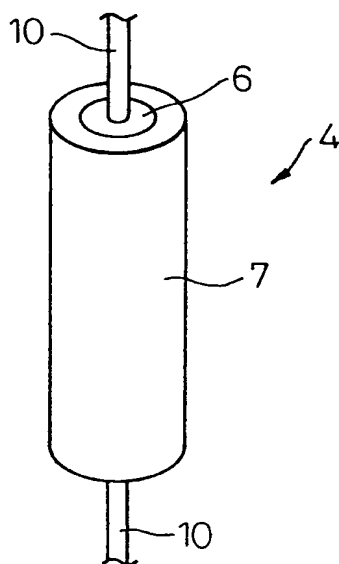
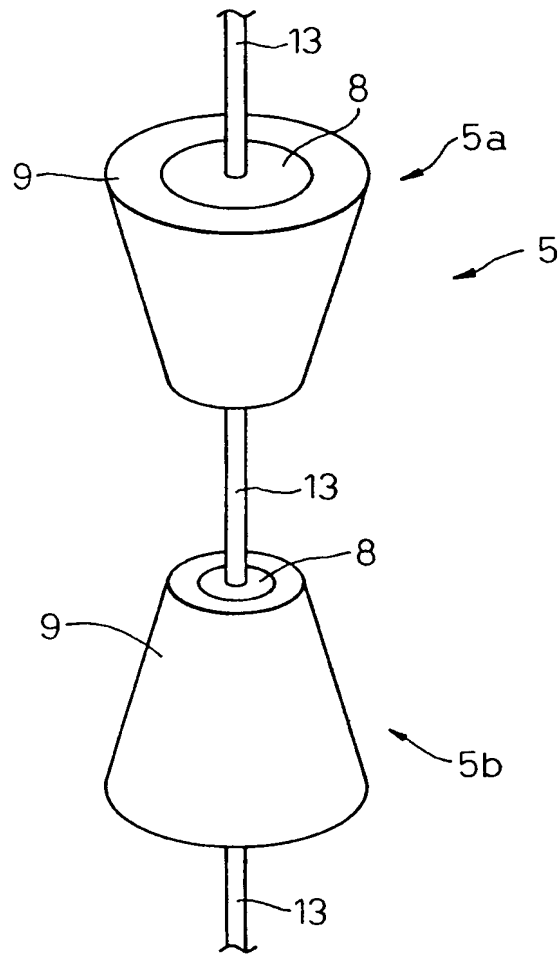


Fig. 7

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**Fig. 8**

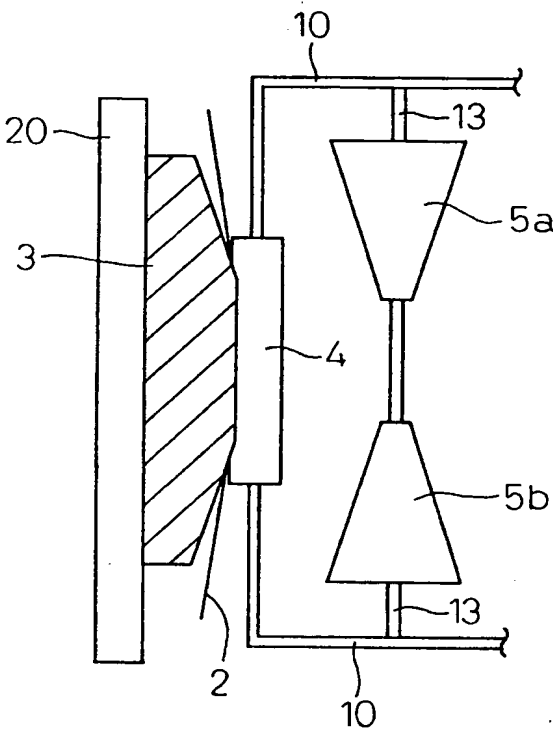
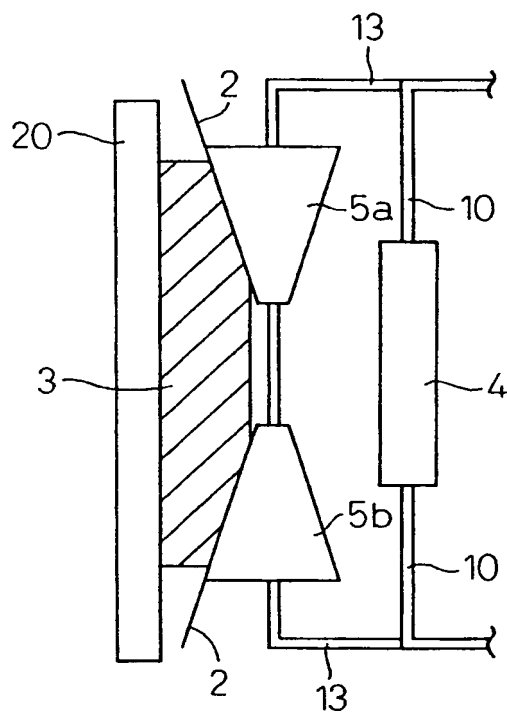
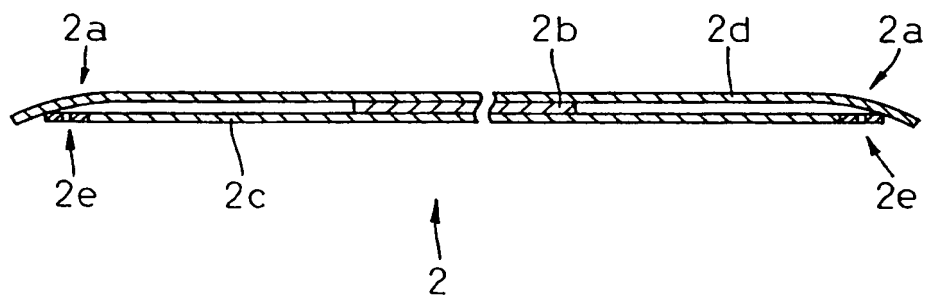


Fig. 9

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**Fig. 10****Fig. 11**